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LETTERS PATENT APPLICATION

Method For Predictive Determination of Financial Investment Performance

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a method of forecasting the short run trend of a financial variable and, in particular, of forecasting performance of investment instruments such as stocks, bonds, commodities, etc.

2. Description of the Related Art

With the development of statistical analysis and the long-standing interest in the performance of the financial markets, numerous methods have been developed and utilized in an attempt to forecast future trends of financial variables, such as the prices of stocks, bonds and commodities. Such methods typically apply financial analysis tools characterized by a high degree of statistical rigor without consideration of the actual past occurrences affecting the financial market. Trends in financial markets are a mixture of rational and irrational factors. Existing forecasting tools which are grounded in technical data analysis, such as moving averages, momentum indicators, pattern graphs or theories about cycles or periodic waves are based on ineffective algorithms which yield ineffective results.

SUMMARY OF THE INVENTION

The present invention provides a computerized or automated method of predicting financial market performance and, in particular, stock and financial instrument performance based on an analysis of various factors and market indicators. The inventive method is based on time series of variables associated with a particular item of interest or target data such as the price of a particular company stock, and is used to determine the probability that a condition of the target data will occur, e.g. whether a stock price will increase. This is accomplished by analyzing multiple time series associated with the target data, such as the closing price, opening price, differences between closing and opening prices, etc., for successive trading days. This analysis yields a plurality of differential time series for various parameters associated with the target dates. The differential time series are then examined to locate continuous trends or subseries where, for example, the stock price increases over several days, etc., and statistical calculations are then performed on the subseries to yield a probability of the occurrence of a particular condition.

In a preferred embodiment, the statistical series calculations are performed on three classes of parameter series, referred to as Trend Parameters (TP), Additional Trend (Add-Trend) Parameters (ATP), and Volatility Parameters (VP), and weighting factors are used to increase or decrease the relative significance of select parameters based upon user specified conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 depicts a flow chart of the inventive method;

FIG. 2 is an example of a parameter time series and several variable time series derived therefrom for use with the inventive method;

FIG. 3 shows certain criteria conditions for performing a step of the inventive method;

FIGs. 4 and 5 depict additional steps of the inventive method;

FIGs. 6-7 show alternative criteria to those listed in FIG. 3;

FIGs. 8A and 8B are listings of parameters and their definitions for use with the present invention; and

FIG. 9 is an example of calculating several variable time series derived from the parameters of FIGs. 8A and 8B for use with the method.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENTS

Section 1

The predictive determination method in accordance with the present invention for estimating market performance of a market variable is illustrated in the flow chart of FIG. 1. The method is used to calculate, based on a plurality of parameters, the probability that a certain result may occur concerning a market variable, such as a company stock, bond, treasury note, commodity, etc. A presently preferred list of the plurality of parameters used in the inventive method is contained in the table of FIGs. 8A and 8B. The parameters are segregated or grouped or arranged into a Trend Parameters (TP), Additional Trend or Add-Trend Parameters (ATP), and Volatility Parameters (VP). As presently contemplated, there are 36 total parameters (14 TP, 16 ATP and 6 VP) which are defined in the table. It is noted that the parameter list contained in the table is non-exhaustive and additional parameters or substitute parameters may be used without departing from the scope of the present invention. Likewise, fewer than 36 parameters can be used with the inventive method.

The method utilizes a history or time series of each of the selected parameters as a basis for the probability calculations. For example, if the information or data sought concerns a particular company stock, such as IBM, a starting time or date is selected (e.g. May 2, 1970) and values of each selected parameter are obtained to establish a plurality of time series (one for each parameter) from the starting date to the present date. Presumably, there will be a series term for each date in which the IBM stock is traded from the starting date through the present, thereby resulting in a plurality of numeric series containing successive-in-time terms. As an example, if one of the parameters is a Trend Parameter and, in particular, the closing price of IBM stock for

each trading day, the closing price Trend Parameter series will contain the closing prices of successive-in-time trading days from the start date until the present. The goal of the present invention is then to provide an analysis method or tool to forecast or predict the closing price that will occur in the near future, i.e. the next trading day or the trading day following the next trading day, etc. The time series needed for performing the predictive method are preferably obtained from one or more databases containing financial market data.

Once the time series corresponding to each selected parameter is obtained, a differential between successive adjacent-in-time terms in each series is calculated. Thus, if the parameter is the closing price of a stock, the differences between adjacent daily closing prices will be obtained. For a series of n terms, this will result in n-1 calculations having the possibility of positive values (signifying an increase in price between adjacent days), negative values (signifying a decrease in price between adjacent days), and zero values (signifying no change). For Trend Parameters and Add-Trend Parameters, a percentage variation (PV) of the resulting series values is designated as ALPHA and calculated as $PV = [(V(ti)-V(ti-1)/V(ti-1)] * 100$, where $i=1,2,\ldots,n-1$; PV can be positive, negative or equal to zero. For the Volatility Parameter series ALPHA is the simple variation (SV), calculated as $SV = V(ti)-V(ti-1)$; where SV can be positive, negative or equal to zero.

With reference to the example shown in FIG. 2, a closing price Trend Parameter series is shown having 26 values from April 12 through May 7, 2000. It should be noted that the value dates are successive for the sake of simplicity and that for an actual investment instrument, the series terms will correspond to a 5-day trading week (Monday-Friday). As shown, the value of ALPHA for the second series term (corresponding to April 13) is 0.91%, given by PV=(55.5-

55)/55*100; for the third day (April 14), the value of ALPHA is 0.54%, given by PV=[(55.80-55.50)/55.50] * 100, and for the fourth day is 0.36%, and so on.

Once the ALPHA series for each parameter series is obtained, each ALPHA(ti) series is examined to locate multiple day trends or subseries. Such subseries are designated when a common trend (up, down or unchanged) occurs. Thus, and with reference to the example of FIG.2, ALPHA(ti) shows a three-day up trend from April 13 through April 15 followed by a single day down trend, a single day up trend, a three day down trend from April 18 through April 20, etc. After the subseries of multiday increases/decreases are located, the percentage variation (in the case of a Trend or Add Trend Parameter) or the simple variation (in the case of a Volatility Parameter) is calculated for the parameter values corresponding to the local subseries: each local subseries or trend is given by all consecutive ALPHA(ti) having the same sign (positive, negative, unchanged). The cumulative variations of all consecutive ALPHA(ti) having the same sign are designated as BETA. Thus, the Trend Parameter (closing price) of the example in FIG. 2 has a three-day increase trend from April 13 through April 15. The first parameter value in this trend is 55.00. The first BETA value therefore is [(55.5 - 55)/55]* 100, or 0.91%. The second BETA value is [(55.8 - 55)/55] * 100, or 1.45%, and the third value is [(56 - 55)/55] * 100 or 1.82%. Thus, for every n-day trend, there are n-1 BETA(ti) values. It is also noted that the first value of BETA for each new trend equals the corresponding value of ALPHA and that the sign trends for ALPHA and BETA are equivalent such that when ALPHA is positive, BETA is positive and *vice versa*.

Once the BETA series for each parameter is obtained, each BETA(ti) series is examined to locate the sign and the sequence of multiple day trends or subseries. This

performance trend is designated as GAMMA and, as shown in FIG. 2, corresponds to the price as well as the values of ALPHA and BETA. Thus, for the first value term (April 13) GAMMA is "1 up", for the second value term (April 14) GAMMA is "2 up", for the third value term, GAMMA is "3 up", for the fourth value term, GAMMA is "1 down", and so on. It should be noted that GAMMA has the same sign as ALPHA and BETA.

Thus, and as explained above, for a series of n terms, for each parameter, n-1 ALPHA(ti), BETA(ti) and GAMMA(ti) are calculated, where i=1,2,....(n-1). ALPHA is the variation of adjacent-in-time term values (example in FIG. 2, 0.91%, 0.54%, or 0.36%); BETA is the cumulative variation (example, 0.91%, 1.45%, 1.82%) of all consecutive ALPHA having the same sign (positive, negative, unchanged); and GAMMA is the cumulative variation sign (example, "1 up", "2 up", "3 up") of all consecutive ALPHA having the same sign.

After the series terms for ALPHA(ti), BETA(ti) and GAMMA(ti) are determined, the values of these series terms at the present day are selected as a reference or comparison guide for use in predicting the parameter performance in the following parameter trading day. The series are examined to select past values that correspond or correlate with the present day values based on certain series criteria. For example, the present or <u>last available values</u> for ALPHA, BETA and GAMMA in FIG. 2 are 0.27, 0.63 and "2 up", respectively. These values are designated as ALPHA(t)*, BETA(t)* and GAMMA(t)* and they represent the structure of the price action (ALPHA, BETA and GAMMA) related to the current market condition.

<u>Section 2</u>

A search is then conducted in the time series of ALPHA, BETA and GAMMA for each parameter to ascertain the parameter values concurring with the values of ALPHA(ti),

BETA(ti) and GAMMA(ti) that match certain criteria based on the present values ALPHA(t)*, BETA(t)* and GAMMA(t)*. Preferred criteria in locating concurring values are listed in FIG. 3, wherein for the example of FIG. 2, a search is conducted for ALPHA(t)*>=0.27, BETA(t)*>=0.63 and GAMMA(t)*=2up. Alternatively, other criteria could have been selected, such as ALPHA(t)*>=0, BETA(t)*>=0 and GAMMA(t)*=2up, i.e. for an ALPHA value within an established range (e.g. between 0 and the value of ALPHA(t)* (0.27)). As a further alternative, the search may locate values of ALPHA and BETA based on criteria that coincide with the GAMMA(t)* value, e.g., ALPHA between 0 and ALPHA(t)* with corresponding BETA between 0 and BETA(t)*. Numerous criteria can be selected for this purpose and several examples are depicted in FIGs. 6-7. The following criteria are presently preferred as the General Criteria of Selection/Inquiry to determine the *basis of probability*:

<u>For values of ALPHA(t)* positive or equal to zero</u>

GAMMA(ti) => GAMMA(t)*;
ALPHA(ti) =>X1;
X1 <=ALPHA(ti) =<Y1;   where 0<=X1<Y1, 0<=X2<Y2
BETA(ti) =>X2;
X2<=BETA(ti) =<Y2;

<u>For values of ALPHA(t)* negative or equal to zero</u>

GAMMA(ti) =< GAMMA(t)*;
ALPHA(ti) =<X1;
Y1 <=ALPHA(ti) =<X1;   where 0>=X1>Y1, 0>=X2>Y2
BETA(ti) =<X2;
Y2<=BETA(ti) =<X2;

In FIG. 4, the step-by-step analysis is listed according to the example of FIG. 2 and the criteria of FIG. 3. In that case, the criteria are GAMMA(ti)=GAMMA(t)*=2up;

ALPHA(ti)=>ALPHA(t)*=0.27 and BETA(ti)>=BETA(t)*=0.63. Three days are located in FIG. 2 which satisfy such criteria at the same time, namely, line number 3 (April 14); line number 13 (April 24) and line number 19 (April 30). This is shown in step 1 of FIG. 4. Once this calculation is performed and the number of parameter term occurrences satisfying a user specified criteria for ALPHA, BETA and GAMMA is determined, the total number of occurrences or "hits" are summed as X. In FIG. 4, X = 3 which is defined as the *basis of probability*.

Section 3

The values of the next-occurring or successive ALPHA values following the determination of the values comprising X are then obtained. For example, if the values of ALPHA(ti), BETA(ti) and GAMMA(ti) meeting the selected criteria correspond to a time (ti), e.g. April 14, the value at t+1 (e.g. April 15) is selected (ALPHA at (ti+1)=0.36).

Based on this result obtained from the ALPHA(ti), BETA(ti) and GAMMA(ti) values of each parameter time series (Trend, Add-Trend and Volatility parameters), the variations of ALPHA(ti+1) are grouped according to their sign and summed. Specifically, the amount of all occurrences of positive ALPHA(ti+1) are added and defined as *K*; the amount of all occurrences of negative ALPHA(ti+1) are added and defined as *J*; and the amount of occurrences of ALPHA(ti+1) equal to zero is identified as *Y*. The sum of K+J+Y = X. In FIG. 4, K=2, J=0, Y=1. From these values, the percentage values can be determined as Pk=(K/X)*100, Pj=(J/X)*100, Py = (Y/X)*100. By definition, the sum of Pk, Pj and Py is equal to 100.

Given the time series and the so calculated *basis of probability*, the percentage values of Pk, Pj and Py represent the historical probability of a positive, negative and neutral

variation, respectively, that an up trend, down trend and unchanged trend will occur on the following day. If these calculations are performed on the parameters listed in FIGs. 8A and 8B, a result of 14 Trend Parameters Pk, Pj and Py, 16 Add-Trend Parameters Pk, Pj and Py, and 6 Volatility Parameters Pk, Pj and Py will be realized.

The categories of the historical probability calculations are then considered separately and weighting factors can be assigned based upon a particular user's preference. Preferably, each parameter in each parameter series will have a corresponding weighting factor. Each weighting factor (Wi) is a positive fraction used to form a product with its corresponding probability factor, and then a sum of all products is calculated. Thus, in the case of the 14 Trend Parameters, there are 14 weighting factors (W1-W14) and the following sums are calculated:

$$PK = Pk1*W1 + Pk2*W2 + \ldots.. + Pk14*W14$$
$$PJ = Pj1*W1 + Pj2*W2 + \ldots.. + Pj14*W14$$
$$PY = Py1*W1 + Py2*W2 + \ldots.. + Py14*W14$$

The weighting factors are used to selectively discount and/or add significance to certain parameters. For example, if a user considers a stock closing price to be of particular importance relative to a different parameter (e.g. a stock opening price), then the opening price trend parameter may be assigned a weight smaller than a weight assigned to the closing price weight parameter. The resulting calculations (i.e. PK, PJ, PY) are performed for the Add-Trend and Volatility Parameters as well.

The probability index for the Trend, Add-Trend and Volatility Parameters are then calculated from the resulting weighted probabilities to achieve a probability that a particular event may occur, e.g. that a stock price will increase or decrease, the volatility surrounding the prediction, etc. This is accomplished from the sum of the greater of the maximum value of either

PK or PJ, i.e., max(PK;PJ), and a weighted ratio of that maximum number, i.e. max(PK;PJ)/100*PY*r*s, where s and r are additional weighting factors used to add or remove significance to the particular probability indices and of the discount factor max(PK;PJ)/100, and assuming PY values are negligible. Thus, the Trend Probability Index is calculated by:

$$\textbf{Trend Probability Index (TPI)} = \mathbf{\max(PK;PJ)+\max(PK;PJ)/100*PY*r*s}$$

In general, s and r are greater than zero and are used to customize the importance of factor PY, i.e. the importance of unchanged trend probability.

The Add-Trend Probability Index and the Volatility Probability Index are given by the same Trend Probability Index formula as set forth above except that the values of PK, PJ and PY are taken from the Add-Trend and Volatility Trend parameters, respectively.

In the example listed in FIG. 5 step 4, four parameters have been considered, namely, high, low, open and closing prices - weighted by 25%, 25%, 10%, and 40% respectively. PK, which represent the historical probability that an uptrend will occur is equal to 58.55, whereas PJ, which represent the historical probability that a downtrend will occur is equal to 39.95. PY which represents the historical probability the price will not change is equal to 1.50. The Trend Probability Index (TPI) represents the synthetic indicator of the trend as explained by the calculated historical probabilities. In the example, TPI is equal to “UP 59.4%”, and it indicates that tomorrow it is more likely that an uptrend will occur. Should for example TPI be “DOWN 66%”, it would indicate that tomorrow it is more likely a downtrend would occur.

Once the Trend, Add-Trend and Volatility Probability Indexes are calculated as above, the same process is performed for the Main Parameters, i.e. the non-volatility parameters listed in FIG. 8A. In other words, in FIG. 8A there are 30 non-volatility or "main parameters"

and in FIG. 8B there are 6 volatility parameters. Thus, 30 weights are used, and the Main Trend Probability Index is calculated as:

MTPI= max(PK;PJ)+max(PK;PJ)/100*PY*r*s; where, as above, s and r are additional weighting factors used to add or remove significance to the particular probability indices and of the discount factor max(PK;PJ)/100, and assuming PY values are negligible.

Section 4

In Section 3 historical probabilities are calculated by taking into consideration all values of ALPHA(ti+1) related to the selected values of ALPHA(ti). When we say all values we mean all positive values related to positive ALPHA, all negative values related to negative ALPHA and so on. In other words, so far we have not taken into account the amount of the variation, just the sign. Now, we want to consider even the amount of the variation occurred in ALPHA(t+1). The difference is implied in the following questions: "what is the probability that tomorrow the closing price will go up?" and "what is the probability that tomorrow the closing price will go up *by at least 1%?*".

Therefore, the invention can give an answer to questions like the following: what is the probability that the today IBM closing price will change by at least -0.10% tomorrow? Once we have determined the *basis of probability* - according to the criteria related to GAMMA(t)*, ALPHA(t)* and BETA(t)* as described in Section 2. - the selection of values in ALPHA(ti+1) will regard only those values smaller than -0.10%, regardless values greater than -0.10%. Were the question "what is the probability that the today IBM closing price would change by at least 1.0% tomorrow", we would select all those values of ALPHA(ti+1) equals to 1.0% or greater, without taking into consideration all values smaller than 1.0%. Assuming for example that the

basis of probability (X) is 80 occurrences (in ALPHA(ti)), and that in ALPHA(ti+1) we find out 3 unchanged values, 22 negative values, 40 positive values smaller than 1% and 15 values greater than 1%, the probability will be given by the ratio 15/80*100=18.75%. Were the inquiry "what is the probability that the today IBM closing price will increase by not more than 1.0% tomorrow", the probability would be given by the ratio 40/80*100=50%. In general, given a certain basis of probability (see Section 2), the probability that the *today* (t) IBM closing price will change by at least -0.10% *tomorrow* (t+1) can be generalized by saying that -0.10% can be defined ALPHA(t+1)*% equals to $(V_{(t+1)*}-V_{(t)})/V_{(t)}$, being V(t) the today IBM closing price and V(t+1)* what we define the *target price,* that is to say, the desired or projected price for tomorrow (t+1). In the example, assuming V(t)=55 and ALPHA(t+1)*=-0.10%, V(t+1)* is equal to 54.945. In this case, the probability is given by the percentage ratio between all occurred values in the time series matching ALPHA(ti+1)<=ALPHA(t+1)*=-0.10% and the basis of probability (X). Given the today IBM closing price, the user can first set the desired target price V(t+1)* and then get the value of ALPHA(t+1)* or, *vice versa*, he can first set the desired ALPHA(t+1)* and then get the target price V(t+1)* [given V(t), $V_{(t+1)*}=V_{(t)}$times(1+$ALPHA_{(t+1)*}$%) or $ALPHA_{(t+1)*}\%=(V_{(t+1)*}-V_{(t)})/V_{(t)}$]. It can be noted that ALPHA(t+1)* can be defined as the user's desired *target percentage change in (t+1)*, whereas V(t+1)* can be defined as the user's desired *target price in (t+1)*.

Section 5

In Section 2 for determining the *basis of probability* the method has been described using the last available values (e.g. present day values at time=t) of ALPHA(t), BETA(t) and GAMMA(t) and designating such values as ALPHA(t)*, BETA(t)*, and GAMMA(t)*, that

represent the structure of the price action related to the current market condition. It should be noted that instead of using only the last available values (t), it may be desirable also to use the next-to-last available values (t-1). Assuming for example that, before occurring a positive variation (1up) in the last available day (t), the next-to-last available values show a negative trend characterized by 4 consecutive down (GAMMA=4down). In this case the user could be interested in including within the criteria of selection even those events matching GAMMA=4down. For example, if the criteria of selection were GAMMA(t)*=1up, ALPHA(t)*>=0.20%, and BETA(t)*>=0.20% (for the last available day), we would obtain a basis of probability of, let us say, 150 occurrences. If we include also GAMMA(t-1)*=4down among the criteria of selection to determine the basis of probability, we need to match occurrences of GAMMA(ti)=GAMMA(t-1)*=4down, *followed on the day after* by GAMMA(t)*=1up, ALPHA(t)*>=0.20%, and BETA(t)*>=0.20%, and, accordingly, the basis of probability would be different (and for sure smaller than 150 occurrences), as we increased the criteria of selection. In other words, by changing (in the example, adding) the criteria of selection to determine the basis of probability, we change the basis of probability itself. In this case the selection has been made applying the criteria on two different days: GAMMA(t)*=1up, ALPHA(t)*>=0.20%, and BETA(t)*>=0.20%, for the last available day (t) and GAMMA(t-1)*=4down, for the next-to-last available day (t-1). More generally, the *basis of probability* has been performed by selecting occurrences in the time series matching 1) all values GAMMA(ti)=GAMMA(t-1)*=4down; *and* 2) all values GAMMA(ti+1)=GAMMA(t)*=1up, ALPHA(ti+1)>=ALPHA(t)*=0.20%, and BETA(ti+1)>=BETA(t)*=0.20%, at the same time. Therefore, summing up contents of

Section 2 and the above, the general criteria for determining the *basis of probability* are to be chosen among the following:

For *each possible* ALPHA(t-n)* being t the time of the last available data and n=0, 1, 2 ...

For values of ALPHA(t-n)* positive or equal to zero

$\text{GAMMA(ti-n)} => \text{GAMMA(t-n)*};$
$\text{ALPHA(ti-n)} => X1;$
$X1 <= \text{ALPHA(ti-n)} =< Y1;$ where $0 <= X1 < Y1,\ 0 <= X2 < Y2$
$\text{BETA(ti-n)} => X2;$
$X2 <= \text{BETA(ti-n)} =< Y2;$

For values of ALPHA(t-n)* negative or equal to zero

$\text{GAMMA(ti-n)} =< \text{GAMMA(t-n)*};$
$\text{ALPHA(ti-n)} =< X1;$
$Y1 <= \text{ALPHA(ti-n)} =< X1;$ where $0 >= X1 > Y1,\ 0 >= X2 > Y2$
$\text{BETA(ti-n)} =< X2;$
$Y2 <= \text{BETA(ti-n)} =< X2;$

Once the calculation is performed for each possible ALPHA(t-n)* according to the selected criteria, the *basis of probability* will be given by the total number of occurrences or "hits" related to ALPHA(ti), BETA(ti) and GAMMA(ti) resulting from selecting all values of each ALPHA(ti-n), BETA(ti-n) and GAMMA(ti-n) matching respectively each ALPHA(ti-n)*, BETA(ti-n)* and GAMMA(ti-n)* at the same time and according to the time order (from the highest value of n to n=0). Therefore, the structure of the price action related to the current market condition very often refers only to the last available data, but sometimes even to data related to previous days. In either case, we refer to the *current* market condition.

Section 6

In Section 4. we have considered the probability of an event occurring the *day after* (t+1) the last available day (t) of the time series: given a certain basis of probability, the user can look up desired values of ALPHA(t+1)*, that is to say, values ALPHA(t+1) occurred "tomorrow" (t+1) in the time series matching ALPHA(t+1)*. The method can be used also to forecast the probability of occurrence of a specific event 1) *on* a time (t+n); 2) *by* a time (t+n) ; or 3) on a time (t+n) subject to the occurrence of an event on a time (t+n;m), being m=n+q, q=1,2,..

More generally, besides to what we have described in Section 4., that is to say,

1. the probability **P(t+1)** that the *today* (t) IBM closing price will change by at least -0.10% *tomorrow* (t+1), being ALPHA(t+1)*=-0.10%;

the method can also provide the users with:

2. the probability **P(t+2)** that the *today* (t) IBM closing price will change by at least -0.10% *on the day after tomorrow* (t+2), being ALPHA(t+2)*=-0.10%;
3. the probability **P(t#2)** that the *today* (t) IBM closing price will change by at least -0.10% *by the day after tomorrow* (t+2), being ALPHA(t#2)*=-0.10%;
4. the probability **P(t+1;2)** that the *tomorrow* (t+1) IBM closing price will change by at least -0.10% *on the day after tomorrow* (t+2), being ALPHA(t+1;2)*=-0.10%

The first 3 probabilities may be calculated upon the same basis of probability, whereas P(t+1;2) is necessarily calculated upon a different basis of probability.

The only difference between **P(t+1)** and **P(t+2)** is that P(t+1) is calculated by matching occurrences in the time series of values ALPHA(ti+1)< =ALPHA(t+1)*=-0.10% as above described; whereas P(t+2) is calculated by matching occurrences of values ALPHA(ti+2)< =ALPHA(t+2)*=-0.10%, being values of $ALPHA_{(t+2)*}\% = (V_{(t+2)*} - V_{(t)})/V_{(t)}$. In general, given a certain basis of probability (X), the probability P(t+n) that the *today* (t) IBM closing price will change by at least -0.10% *on the n-th day from today* (t+n) is given by the percentage ratio of the number of occurrences in the time series of values ALPHA(t+n) matching ALPHA(t+n)*, above X (given V(t), $V_{(t+n)*} = V_{(t)}\text{times}(1+ALPHA_{(t+n)*}\%)$ or $ALPHA_{(t+n)*}\% = (V_{(t+n)*} - V_{(t)})/V_{(t)}$. It can be noted that ALPHA(t+n)* can be defined as the user's desired *target percentage change in (t+n)*, whereas V(t+n)* can be defined as the user's desired *target price in* (*t*+n) (see Fig. 9).

Probabilities **P(t#2)** are calculated by matching occurrences of values ALPHA(ti#2)< =ALPHA(t#2)*=-0.10%, being each selected value of ALPHA(ti#2) in the time series equal to the smallest value between values of ALPHA(ti+1) and ALPHA(ti+2); were ALPHA(t#2)*>0, we would select values of ALPHA(ti#2) equal to the greatest value between values of ALPHA(ti+1) and ALPHA(ti+2) matching in the time series ALPHA(t#2)* (*mutatis mutandis*, as for ALPHA(t#2)*=0). In general, given a certain *basis of probability* (X), the probability P(t#n) that the *today* (t) IBM closing price will change by at least -0.10% *by the n-th day from today* (t+n) is given by the percentage ratio of the number of occurrences in the time series of values ALPHA(ti#n) matching ALPHA(t#n)*, above X (being values of ALPHA(ti#n)

equal to the smallest/greatest/neutral values of all values of ALPHA(ti+n) included from (ti) to (ti+n) [ALPHA(ti+1), ALPHA(ti+2), ...ALPHA(ti+n)], as defined above.

Probability **P(t+1;2)** is calculated upon a different basis of probability, as the starting price is the *tomorrow* (t+1) IBM closing price. As, by definition, we do not know the tomorrow price, we can assume the target price V(t+1)* (as described in Section 4.) as the tomorrow price. Assuming the example for P(t+1) as a reference for this purpose, the *basis of probability* (as a result of a further selection) will be given by matching occurrences of values ALPHA(ti+1)<=ALPHA(t+1)*=-0.10% (see Section 4.). Now we can calculate P(t+1;2) by matching occurrences of values ALPHA(ti+1;2)<=ALPHA(t+1;2)*<=-0.10, being values of $ALPHA_{(t+1;2)*}\% = (V_{(t+1;2)*} - V_{(t+1)*})/V_{(t+1)*}$ and $V_{(t+1)*} = V_{(t)} times (1 + ALPHA_{(t+1)*}\%)$; V(t+1;2)* is the desired target price in (t+2) and ALPHA(t+1;2)* the desired target percentage change in (t+2). P(t+1;2) will be given by the percentage ratio between such matched values and the basis of probability.

Section 7

What we have seen in Sections 4 and 6 can be generalized as follows:

- given a certain *basis of probability*, the probability **P(t+n)** that the IBM closing price *taken* in the last available time unit of the time series (t) will change by (at least, at most, etc.) a certain percentage value ALPHA(t+n)* *on* the time (t+n), being n=1,2,...; given V(t) the IBM closing price taken in (t), $V_{(t+n)*} = V_{(t)} times (1 + ALPHA_{(t+n)*}\%)$ or $ALPHA_{(t+n)*}\% = (V_{(t+n)*} - V_{(t)})/V_{(t)}$; being ALPHA(t+n)* the percentage change selected by the user according to the following possible general criteria:

  ALPHA(t+n)*<>=x1;

x1< =ALPHA(t+n)*< =x2;

being x1 and x2 < > =0 and x1< >x2;

is given by the percentage ratio between the number of occurrences in the time series of values ALPHA(ti+n) matching ALPHA(t+n)* according to the selected criteria, and the basis of probability;

- given a certain *basis of probability*, the probability **P(t#n)** that the IBM closing price *taken* in the last available time unit of the time series (t) will change by (at least, at most, etc.) a certain percentage value ALPHA(t#n)* by the time (t+n), being n=1,2,...; given V(t) the IBM closing price taken in (t), $V_{(t\#n)*}=V_{(t)}\text{times}(1+ALPHA_{(t\#n)*}\%)$ or $ALPHA_{(t\#n)*}\%=(V_{(t\#n)*}-V_{(t)})/V_{(t)}$; being ALPHA(t#n)* the percentage change selected by the user according to the following possible general criteria:

  ALPHA(t#n)*< > =x1;
  x1< =ALPHA(t#n)*< =x2;
  being x1 and x2 < > =0 and x1< >x2;

  is given by the percentage ratio between the number of occurrences in the time series of values ALPHA(ti#n) matching ALPHA(t#n)* according to the selected criteria, and the basis of calculation, being values of ALPHA(ti#n) equal to the smallest/greatest/neutral values of all values of ALPHA(ti+n) included from (ti) to (ti+n) [ALPHA(ti+1), ALPHA(ti+2), ...ALPHA(ti+n)], as defined above.

- given a certain *basis of probability*, the probability **P(t+n;m)** that the IBM closing price *assumed* in the time (t+n) will change by (at least, at most, etc.) a certain percentage value ALPHA(t+n;m)* on the time (m), being m=n+q and q=1,2,...; given V(t+n)* the IBM closing price assumed in (t+n),

$V_{(t+n;m)*} = V_{(t+n)*}\mathrm{times}(1+ALPHA_{(t+n;m)*}\%)$ or $ALPHA_{(t+n;m)*}\% = (V_{(t+n;m)*} - V_{(t+n)*})/V_{(t+n)*}$; being ALPHA(t+n;m)* the percentage change selected by the user according to the following possible general criteria:

ALPHA(t+n;m)* < > =x1;
x1 < > =ALPHA(t+n;m)* < > =x2;
being x1 and x2 < > =0 and x1 < > x2;

is given by the percentage ratio between the number of occurrences in the time series of values ALPHA(ti+n;m) matching ALPHA(t+n;m)* according to the selected criteria, and the basis of probability.

It should be noted that as for the Trend and Add-Trend Parameters, variations are to be considered in percentage term, whereas for the Volatility Parameters variations are in absolute term.

Furthermore, having defined P(t+n), P(t#n) and P(t+n;m), the invention can also perform combinations of them, such as P(t+n;#m), P(t#n;#m), and so on.

Section 8

Once obtained probabilities determined according to one of the criteria described above, the same procedure as discussed in Section 3 can be applied to calculate the TPI, the VPI and the MTPI, by changing accordingly what it needs to be changed in order to obtain consistent and meaningful indeces.

It should be further noted that although the inventive method has been described above in the context of obtaining the uptrend, downtrend and unchanged trend of a financial variable (e.g. a stock or bond price), the method may be equally applied to any time series represented variable. Moreover, although the method has been described using a daily time unit

(e.g., a daily time series), it can be equally performed using time series of larger or smaller time units, up to a one-week time unit, such as an hour, half day, two-day or weekly unit (e.g. weekly closing price, etc.). However, the preferred method obtains accurate probability readings utilizing daily time series.

The method can additionally be used to derive compound probabilities based on the resulting probabilities derived from the method described above, such as to calculate the probability of the occurrence of two or more events at the same time, regarding two or more parameters of the same variable or two or more different variables (we consider just independent events). For example, if the method is used to calculate the PK, PJ and PY values for IBM (as PK1, PJ1 and PY1) and General Motors (as PK2, PJ2 and PY2) stock, the probability that an up trend will concurrently occur for both is given by PK1*PK2/100. Likewise, the probability that an up trend will occur for only one of the two stocks is given by PK1+PK2- PK2*PK1/100, etc.

The inventive method described above can be easily implemented using a general purpose digital computer running a dedicated software application such as Microsoft Excel or other spreadsheet-type program. The parameter terms can be accessed from a digital storage medium integrally formed with or proximately located by the computer or remotely accessed by the computer, with the database containing a history of financial market variables such as the closing prices of stocks, etc.

Thus, while there have shown and described and pointed out fundamental novel features of the invention as applied to preferred embodiments thereof, it will be understood that various omissions and substitutions and changes in the form and details of the method illustrated may be made by those skilled in the art without departing from the spirit of the

invention. For example, it is expressly intended that all combinations of those method steps which perform substantially the same function in substantially the same way to achieve the same results are within the scope of the invention. Moreover, it should be recognized that steps and/or described in connection with any disclosed embodiment of the invention may be incorporated in any other disclosed or described or suggested form or embodiment as a general matter of design choice. It is the intention, therefore, to be limited only as indicated by the scope of the claims appended hereto.